

Testimony for October 30, 2003, to the Research Subcommittee of the
U.S. House of Representatives Committee on Science Hearing,
**“Implementation of the Math and Science Partnership Program:
Views from the Field”**

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Good afternoon Chairman Smith, Ranking Member Johnson and Members of the Subcommittee: It is a pleasure to appear before the Subcommittee and provide testimony on the Math and Science Partnership Project - PROM/SE - presently at the early stage of implementation at Michigan State University. Michigan State University and its five K-12 partners -- St. Clair County, Ingham County, and Calhoun County Intermediate School Districts in Michigan, and the High AIMS and SMART consortia in Ohio – have joined in Project PROM/SE (Promoting Rigorous Outcomes in Mathematics and Science Education), and on September 26, 2003 were notified that their \$35,000,000 Math Science Partnership project would be funded by the National Science Foundation. At Michigan State University, Dr. William Schmidt and I are the co-leaders of this effort.

Partnership goals

PROM/SE has four goals:

- Gather empirical evidence as a basis for revising content standards, aligning instructional materials with those standards, and monitoring student learning.
- Improve mathematics and science opportunities for all students, especially those from underrepresented and disadvantaged groups by developing more coherent, focused and challenging content standards; aligning standards with instructional materials; and eliminating tracking in grades K-8.
- Improve mathematics and science teaching so it is aligned with standards, through subject specific professional development.
- Reform the preparation of future teachers so that teachers at all levels are ready to teach challenging mathematics and science to diverse student populations.

Our theory of how to improve achievement for all children is simple: we need to understand what students know, what standards expect, and what teachers teach, and work to improve all three. At the outset, students in grades 3-12 across the partner sites will be assessed in mathematics and science, using items from the Third International Mathematics and Science Study (TIMSS), as well as other instruments. Teachers will be

surveyed about background, knowledge, preparation, and topics that they teach, and districts will be surveyed about their standards, instructional materials, and professional development. On the basis of data, we will review and revise standards, analyze alignment of standards with curriculum and teaching practice, and provide professional development for teacher leaders, teacher participants, and guidance counselors. Related reform in the MSU teacher education program will be undertaken during this same five-year period together through Teachers for a New Era, a project funded by the Carnegie Corporation.

Lessons learned to date

Although our MSP funding has only recently been announced, this group of partners has been working together to design and envision our effort for more than two years. In particular, the partners share a commitment to the use of data and evidence as key tools in the revision and strengthening of standards and the design and implementation of professional development of teachers so that teachers will be well equipped to teach to high standards. The ultimate goal is improved learning and achievement in mathematics and science for all students.

We are learning that it is crucial to build on the infrastructures that exist in each of these distinct K-12 partners, including the professional development efforts already underway through local resources in all of these areas, and the grade-by-grade standards that are being developed in states to address No Child Left Behind. For instance, MSU has collaborated extensively with our partner in the St. Clair ISD through a project called Promoting Results in Science and Math (PRISM). Initiated in 2000, PRISM is a multi-year collaboration between the ISD and MSU to evaluate and improve the quality of the curriculum and teaching for all students. The first phase involved a thorough analysis of the curriculum. TIMSS assessments were administered in May 2001 to about 17,000 students in grades 3-12. Using these data, St. Clair ISD began in the fall of 2002 the design and implementation of a reformed curriculum and of a customized professional development approach based on the data. St. Clair's experience serves as a showcase for the partnership's evidence-based approach.

Our extensive baseline data-gathering will ensure that we can tailor our program to the unique needs and circumstances of our 69 participating school districts. Each will have access to the results of students' performance and analysis of standards and teacher practice, so that it will be possible to build on a base of knowledge that serves as the foundation for continued improvement.

We also are learning that the enormous challenges of communication and relationship building are central in a project of this magnitude. Engaging school personnel in decision-making and implementation of project ideas from the outset, helping stakeholders within the school communities come to understand and develop commitment to the premises of PROM/SE, and enabling the project working groups to build new cultures

and norms that span mathematics, science, education, and the world of the K-12 schools, are crucial to the success of PROM/SE.

Ensuring that participants remain active in the program

In addition to the hundreds of teachers and school leaders who will have direct roles in the program, and the thousands of teachers who will benefit from the professional development resources that will be designed, more than 50 Michigan State University scientists, mathematicians, and education faculty have agreed to participate in various roles in the project. They will be able to be part of the assessment design and analysis, the design and implementation of the professional development, and the revision and analysis of standards. Two of the MSU co-PIs, Dr. Peter Bates (Chair of the Department of Mathematics) and Dr. George Leroi (Dean of the College of Natural Science) are well positioned to promote and reward the engagement of MSU faculty.

The design of the project relies on sustained participation of personnel in the K-12 sites, including Site Coordinators and PROM/SE Associates, who will work closely with MSU faculty in all aspects of the project. We anticipate that PROM/SE will generate new collaborations and relationships among groups that have not traditionally engaged together in work of this type. Such collaborations are likely to lead to new project and spin-off efforts during the five years of PROM/SE, and, we hope, in the post-PROM/SE years as well.

Tailoring PROM/SE to the unique needs of the participating school districts

With its emphasis on evidence-based improvement, PROM/SE is designed to be responsive to the particular and unique needs of the participating partners. We anticipate finding certain areas of mathematics and science that are strong in some sites, and that need improvement in others, and will build a comprehensive professional development system that allows these sites to access the key areas in which they wish to focus. In addition, because we will be examining local standards in use in the districts, together with data about teachers' instruction, we will have a baseline for articulating the different emphases and instructional priorities across the partner sites. We will build accordingly on these differences in all project efforts.

Because our five K-12 partners span a range of socioeconomic and contextual situations, we also stand to learn a great deal about the ways in which this variation interacts with efforts to improve standards and instructional practice. This requires acknowledging and understanding the differences among the participating districts.

Professional development for pre-service and inservice teachers

Richard Elmore describes the challenges that today's accountability climate creates for teachers in schools: teachers, administrators, and guidance counselors are being asked to "do something new – engage in systematic, continuous improvement in the quality of the

educational experience of students and to subject themselves to the discipline of measuring their success by the metric of students' academic performance" (Elmore, 2002, p. 3). He goes on to assert that few people in K-12 schools are prepared, either through their education or previous experience, to do this. Indeed, our approach in PROM/SE is to help teachers build and use tools, based on evidence, that will help them in this new climate, and to model how this might be achieved nationally. The PROM/SE professional development (PD) model will have as a unique resource the detailed evidence base that allows us to build on information about student achievement, teachers' understanding of the subject matter, the nature of district standards and their alignment with instructional materials. Teachers need to know where students have difficulty, what kinds of difficulties they have, and how to help them overcome them, while moving toward significant content goals in mathematics and science.

Elmore makes the interesting point that "if most of what teachers learn about practice they learn from their own practice, it is imperative to make the conditions and context of that practice supportive of high and cumulative levels of achievement for all students" (Elmore, 2002, p. 19). This has implications for where, when, and how professional development occurs; it needs to be physically close to where the teaching occurs; it needs to happen while teachers are teaching; and the curriculum of professional development needs to be based on the content and challenges that arise for teachers in classrooms. Our model involves a combination of summer experiences and academic year offerings, as well as virtual professional development. By involving principals and counselors, as well as district leaders, we are addressing context and conditions. Our strategy combines a teacher-leader (coaching) model with a technology-based PD curriculum.

Because the students we are trying to impact are located in all of the more than 700 school buildings that our partnership encompasses and because we wish to leave no child behind, we are committed in our PD to "leaving no building behind." This means identifying a resource person for mathematics and for science (the same person for elementary schools) in each school together with the principal and in the case of secondary schools, a counselor as well. The role of PROM/SE Associates will be to understand the data, the way that the data can be used to drive improvement, and the notion of tying instruction and instructional materials to challenging and coherent standards. And, it will be teams of PROM/SE Associates, working with MSU personnel and other district leaders, who actually do the revision of the district and partner standards – an important element for their own professional development.

The professional development for the Associates will occur during summer institutes, weekend workshops in the academic year, and virtually through on-line offerings. The first summer institutes will focus on the revision of standards on the basis of information about student achievement, teacher characteristics, and district context. Associates will also have opportunities to learn about leadership, coaching, and working with their peers to improve mathematics and science teaching. Associates will be prepared to work locally in their districts on the standards revision process, on using student data, and on helping teachers work with a wide array of instructional practices and materials to align

them with local standards. The Associates will begin their work with the larger group of Teacher Participants in partner-site based weekend workshops and in summer institutes. Associates will be involved in providing site-based, ongoing PD for teachers in their districts in the ensuing academic years.

Through the PROM/SE Associates and the MSU-based PROM/SE staff, we ultimately plan to provide PD directly for about 25% of the teachers of mathematics and science in our partner sites; these 4500 teachers will have opportunities to come to summer institutes and academic year workshops sponsored through the project, and to work directly with the District Associates in their buildings. The remaining 12,500 teachers of mathematics and science in the partner sites also will benefit from the activity of PROM/SE; the data and evidence to be gathered in each partner site will be widely available, and the revised content standards will be a resource for all teachers. Research indicates that professional development should be focused on a well-articulated mission, aimed at improving student learning, content driven, derived from analysis of student learning of specific content in a specific setting, based on instructional materials that the teachers are using, and connected with the specific issues of instruction and student learning in the context of actual classrooms (see, for example, Ball, 1997; Cohen & Hill, 2000; Elmore, 2002, p.7; Loucks-Horsley et al., 1998). The PROM/SE PD model will incorporate all of these views, and will have as a unique resource the detailed evidence base that allows us to build on information about students' learning and teachers' understanding of the subject matter. We regard the ongoing professional development of teachers in the partner sites as the most crucial intervention of our PROM/SE activity. Our professional development has three main goals. We will enable teachers to:

- use evidence about student learning to influence their teaching practice
- use coherent and rigorous content standards as a guide to providing all children with opportunities to learn challenging mathematics and science
- employ instructional practices and materials in ways that align with those standards

At this time we envision these professional development activities to be organized topically and to span the K-12 spectrum. Mathematics and science topics will ultimately be determined by what we learn from the data-gathering phase, but we can predict some areas at this time: functions; rational numbers and proportional reasoning; and data and statistics, for example, in mathematics, and properties and changes of matter, structure and functions of living systems, and structure of earth systems in science. In our planning discussions, the K-12 partner sites have expressed a number of needs for their teachers, which include: "how to help teachers develop and implement more rigorous and coherent curriculum" (St. Clair County), "how to build capacity for coaching and building-level support" (Ingham), "getting a handle on data collection and how to use data" (High AIMS), and "doing gap analysis, and delivering the content effectively" (Calhoun). The partners express a sense that teachers' subject matter knowledge for different areas of the

curriculum is uneven, and are concerned that teachers who seem to “have the content” are still unable to “deliver the curriculum.”

After teachers have participated in summer institutes and project workshops, the project will also provide academic year connection to PROM/SE virtually, through a variety of on-line professional development resources for teachers, designed in a virtual PROM/SE Professional Development System. The idea is to establish—beginning with the initial assessment—a culture of collaborative learning, goal-setting and lesson planning, implementation, assessment and evaluation similar to that observed in Japan (Jacobs et al., 1997; Stigler & Hiebert, 1999). We envision using technology both as a repository for resources designed especially for this project, as well as material selected and embedded into our project context. For example, video-conferencing may make possible the sharing of progress, ranging from full district reports on particular innovations, to crafted lessons by a particular group of teachers in a given school. We will examine various platforms, as possible tools to help teachers “make their teaching visible” by creating their own video library of their practice and by developing their capacity to interact with these videos. PROM/SE Associates will be prepared to help teachers in their districts videotape lessons in the focal topic areas for site-based or on-line professional development discussions and will encourage the sharing of these videos within schools as well as across schools within and beyond their district. We will promote the use of monitored chat rooms as well. We will also expand and adapt a set of on-line courses already successfully implemented at MSU to facilitate professional development as part of the Virtual PD; these courses eventually will become part of a set of master’s offerings for inservice teachers interested in refreshing their mathematics and science content knowledge.

Assessing improvements in teacher content knowledge and pedagogy

Beginning with the baseline assessment activities, we will be designing and using new tools for examining teaching knowledge and practice. Over the course of the project we plan to design special studies in selected areas to look more deeply at the relationship of teacher content knowledge and pedagogical content knowledge as it relates to student achievement and to classroom practice. This collection of coordinated research studies will allow us to gain a deeper understanding of these complex relationships. These studies will be designed in consultation with our National Advisors and with the project evaluator.

Coordination with state agencies

MSU faculty in the PROM/SE team have been deeply involved in efforts to revise the Michigan Department of Education Mathematics Standards, and thus have current connections with key state officials involved in assessment and standards. In addition, personnel from the Michigan and Ohio Departments of Education will be invited to serve as members of the project advisory boards and action teams. We will pay particular attention to the maintenance and growth of these relationships over time so that state personnel come to know the capacity that will be generated through PROM/SE, in terms

of school and university faculty who can become engaged in state efforts in mathematics and science education.

Sufficient resources to develop and test our models

We have found that, with the announcement of PROM/SE, a number of districts are inquiring about joining the project – and the PROM/SE Executive Management Team is developing policies and guidelines for the addition of new partners, with the notion that new partners will need to bring their own resources to this effort.

PROM/SE is an ambitious project of enormous scope and complexity. The project team holds as a high priority the idea that we will conduct research around the activities of PROM/SE, so that this effort can provide us with models and understandings of how improvements of this type can be implemented in a range of contexts. We believe the resources are indeed sufficient for the implementation that is planned in PROM/SE, but to conduct the kind of research and evaluation that can truly help us learn from this project and others like it will require additional resources.

Conclusion

The Math Science Partnership Program provides an exciting opportunity for significant improvement of mathematics and science teaching and learning across educational levels beginning in the earliest grades and through the undergraduate years. The improvement toward which all of us in the MSP Programs strive should not be the sole measure of the success of this substantial investment. In addition, we need, as educators and citizens, to learn from the MSP program about the ways in which models, embedded experiments and innovations, and particular implementations of different theories of action all interact with these improvement efforts. Resources and capacity for building strong research agendas around the MSP programs would seem to be essential to ensure a lasting and sustained benefit from this important set of initiatives.

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